Elephant Toothpaste

AIChE at Lamar University

November 2019

1. **Overview**

Catalysts are substances that we can add to chemical reactions to speed them up and maximize the amount the reaction proceeds forward. These “helpers” work by lowering the amount of energy needed for a chemical to react and the reaction occurs quicker. Our bodies use enzymes, a type of catalyst, to break down our food quickly so that our bodies can convert it to usable energy.

1. **Objective**

* Define what catalysts are and their purpose in chemical reactions
* Demonstrate how increasing the reaction rate can impact the physical appearance of the resulting product
* Describe the principles of energy conservation through the generation of heat as a byproduct

1. **Materials**
2. A clean 16-oz plastic soda bottle
3. 1/2 cup 6% hydrogen peroxide
4. 1 Tablespoon (one packet) of dry yeast
5. 3 Tablespoons of warm water
6. Liquid dishwashing soap
7. Food coloring
8. Small cup
9. Safety goggles
10. Gloves
11. Tray
12. **Procedure**
13. Put on safety goggles and gloves
14. Place tray beneath the plastic bottle for easy clean up
15. Add the hydrogen peroxide (H2O2) to the bottle
16. Next, add approximately 10 drops of preferred food coloring
17. Add 1 tablespoon of dish soap into the mixture and gently swirl the bottle to allow for mixing
18. In a separate cup, mix the dry yeast and water together and allow it to become frothy and well mixed
19. Add the yeast mixture to the bottle, via funnel
20. Watch the reaction occur! Stand back!
21. **Theory**

Hydrogen peroxide (H2O2) is a molecule that looks strikingly similar to water (H2O), but the addition of an oxygen molecule makes hydrogen peroxide a much stronger oxidizer than water. This property of H2O2 is depicted in this reaction by the rapid decomposition of hydrogen peroxide into water and elemental oxygen. The yeast contains catalase (a type of catalyst) that speeds up the reaction significantly so that the “explosion” occurs. The dish soap acts as a barrier to the oxygen bubbles that are generated from the reaction, so the bubbles are trapped instead of venting to the atmosphere, which is why foam is generated. Without the presence of catalase, no chemical changes were occurring. This experiment demonstrates the importance of catalysts in carrying out chemical reactions in large scales, such as those in industry. Without these “helpers” some reactions would take very long to occur or would not be able to be carried out because the reactants would not be able to overcome the activation energy barrier. Another key indicator that a reaction occurred was the release of energy in the form of heat, which could be felt on the bottle. This is called an exothermic reaction.